

CLAIMS

1. A semiconductor structure comprising:  
a silicon germanium component; and  
5 a gallium nitride material component.

2. The semiconductor structure of claim 1, wherein the silicon germanium component is a layer.

10 3. The semiconductor structure of claim 2, wherein the silicon germanium layer is formed on a substrate.

4. The semiconductor structure of claim 3, wherein the silicon germanium layer is formed on a silicon substrate.

15 5. The semiconductor structure of claim 2, wherein the silicon germanium layer is formed on a silicon germanium substrate.

20 6. The semiconductor structure of claim 1, wherein the silicon germanium component is a substrate and the gallium nitride component is a layer formed on the silicon germanium substrate.

25 7. The semiconductor structure of claim 1, wherein the gallium nitride component is a layer.

8. The semiconductor structure of claim 7, wherein the gallium nitride layer is formed on a silicon substrate.

30 9. The semiconductor structure of claim 1, wherein the gallium nitride component is a substrate and the silicon germanium component is a layer formed on the gallium nitride substrate.

10. The semiconductor structure of claim 1, wherein the gallium nitride material component is in direct contact with the silicon germanium component.

11. The semiconductor structure of claim 1, further comprising an intermediate layer  
5 formed between the silicon germanium component and the gallium nitride material component.

12. The semiconductor structure of claim 11, wherein the intermediate layer is compositionally graded.

10

13. The semiconductor structure of claim 2, wherein the composition of the silicon germanium layer is graded.

14. The semiconductor structure of claim 13, wherein the germanium concentration  
15 of the silicon germanium layer is increased in a direction away from the substrate.

15. The semiconductor structure of claim 1, wherein the silicon germanium component has a monocrystalline structure.

20 16. The semiconductor structure of claim 1, wherein the silicon germanium component has a thermal expansion coefficient within +/- 25% of the thermal expansion coefficient of the gallium nitride material layer.

17. The semiconductor structure of claim 1, wherein the silicon germanium  
25 component comprises a  $\text{Si}_x\text{Ge}_{(1-x)}$  alloy and x is greater than or equal to 0.7.

18. The semiconductor structure of claim 17, wherein the silicon germanium component comprises a  $\text{Si}_x\text{Ge}_{(1-x)}$  alloy and x is greater than or equal to 0.8.

30 19. The semiconductor structure of claim 1, wherein the gallium nitride material component comprises a  $\text{Al}_x\text{In}_y\text{Ga}_{(1-x-y)}\text{N}$  alloy.

20. The semiconductor structure of claim 19, wherein the sum of (x + y) is less than 0.2.

21. The semiconductor structure of claim 1, wherein the gallium nitride material component comprises GaN.

22. The semiconductor structure of claim 1, wherein the gallium nitride material component has a crack level of less than  $0.005 \mu\text{m}/\mu\text{m}^2$ .

23. The semiconductor structure of claim 1, wherein the gallium nitride material layer forms at least a portion of a device region.

24. The semiconductor structure of claim 1, wherein the structure forms an FET.

25. The semiconductor structure of claim 1, wherein the structure forms an LED.

26. The semiconductor structure of claim 1, wherein the structure forms a laser diode.

27. The semiconductor structure of claim 1, wherein the structure forms a first semiconductor device that includes the silicon germanium component and a second semiconductor device that includes the gallium nitride material component.

28. The semiconductor structure of claim 27, wherein the first semiconductor device is integrated with the second semiconductor device.

29. A semiconductor structure comprising:  
a silicon germanium component; and  
a gallium nitride material layer formed on the silicon germanium component, the gallium nitride material layer having a crack level of less than  $0.005 \mu\text{m}/\mu\text{m}^2$ .

30. A semiconductor structure comprising:  
a silicon substrate;  
a silicon germanium layer formed on the silicon substrate; and  
a gallium nitride material layer formed on the silicon germanium layer.

5

31. A semiconductor structure comprising:  
a substrate;  
a silicon germanium component formed on the substrate; and  
a gallium nitride material component formed on the substrate,  
10 wherein the structure forms a first semiconductor device that includes the silicon  
germanium component and a second semiconductor device that includes the gallium  
nitride material component, the first semiconductor device being integrated with the  
second semiconductor device.

- 15 32. The semiconductor structure of claim 31, wherein the silicon germanium  
component and the gallium nitride component are formed on different portions of the  
substrate.

- 20 33. A method of forming a semiconductor structure comprising:  
forming a gallium nitride material layer on a silicon germanium component.

34. The method of claim 33, wherein the silicon germanium component is a  
substrate.

- 25 35. The method of claim 33, wherein the silicon germanium component is a layer and  
further comprising forming the silicon germanium layer on a substrate.

36. The method of claim 33, wherein comprising forming the silicon germanium  
layer on a silicon substrate.

30

37. The method of claim 33, wherein the silicon germanium component has a thermal expansion coefficient within  $\pm 25\%$  of the thermal expansion coefficient of the gallium nitride material layer.
- 5 38. A method of forming a semiconductor structure comprising:  
forming a silicon germanium layer on a gallium nitride component.